STANDARDS DEVELOPMENT BRANCH OMOE
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BIOLOGICAL SURVEY

OF THE

UPPER WEST BRANCH OF DUFFIN CREEK

1964

ONTARIO WATER RESOURCES COMMISSION

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BIOLOGICAL SURVEY

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UPPER WEST BRANCH OF DUFFIN CREEK

1964

by

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Biology Branch

January, 1966

BIOLOGICAL SURVEY OF THE UPPER WEST BRANCH OF DUFFIN CREEK - 1964

Biological parameters are useful in assessing water quality because they tend to integrate water quality over at least several months prior to the survey and the results are meaningful to people of varied disciplines. Therefore, biological survey of the upper West Branch of Duffin Creek was carried out primarily to assess the effects of treated wastes from the Village of Stouffville on receiving waters.

METHODS

The bottom fauna and fish populations of the river were examined at 10 stations (Fig. 1). Bottom fauna was sampled in mid-October, 1964, and fish populations were estimated using the removal method (Johnson, 1965) in early November.

Bottom fauna

Two collections, using 15 minutes of effort for each were made at each station, one from the bottom and vegetation of pools with a 20-mesh (per inch) seive and one taken directly from stones from riffle areas.

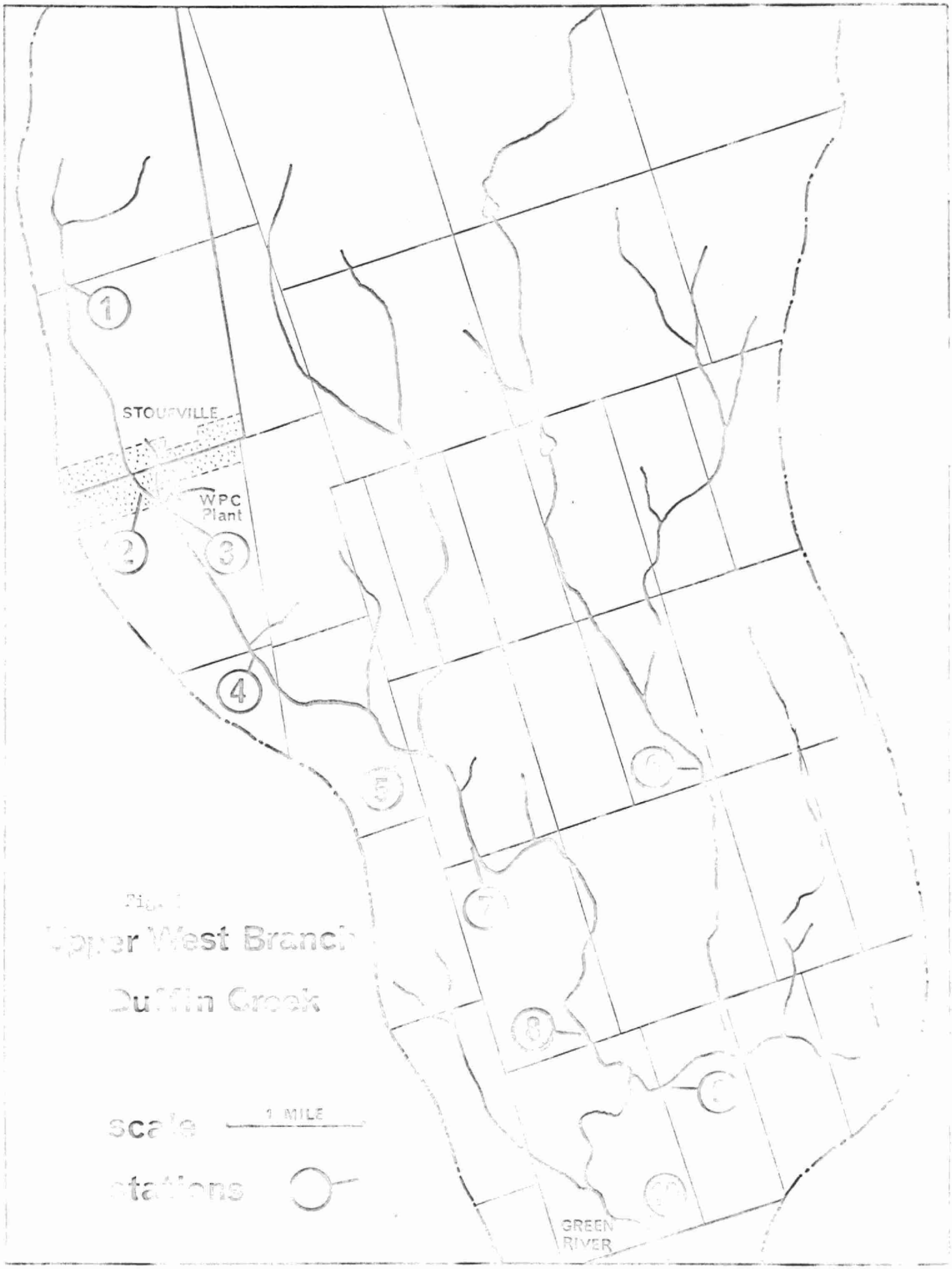
Fish populations

Areas of stream between 0.03 and 0.07 acre were blocked with $\frac{1}{4}$-inch mesh seines. Fish were taken with an electrofishing unit (2 paddles charged by a 0.5-KW, 110 Volt, 60 cycle, a-c generator) in two units of effort, the water being allowed to clear between units. Multinomial estimates of total population were made.

Two stations were located on a second stream adjacent to the Stouffville branch (Stations 6 and 9) to assist in the interpretation of water quality below Stouffville.

DESCRIPTION OF STREAM

The Stouffville branch rises in an area of springs and artesian wells north of the village. Above Stouffville the width of the stream varies between 2 and 15 feet and the depth is at most about 2 feet. Average width and total depth increase downstream to approximately 15 feet and 3 feet at Station 8, where the flow was about 5 cfs at the time of the survey. The adjacent branch has about twice


STOUFFVILLE
WPC Plant
1
2
3
4
5
6
7
8
9
10
GREEN RIVER
Upper West Branch
Duffin Creek
scale 1 MILE
stations

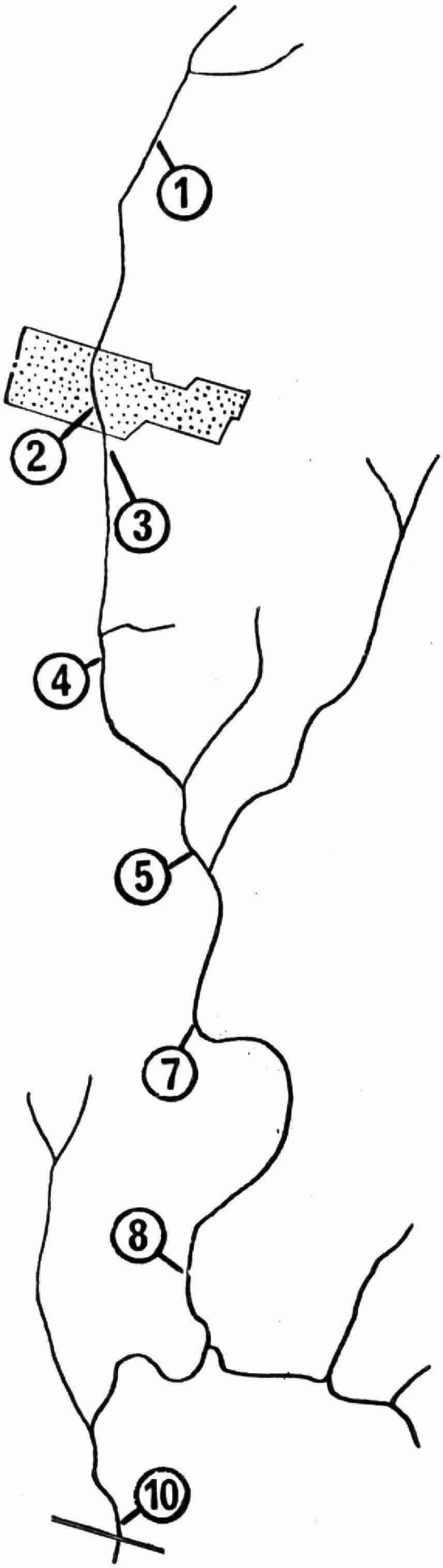
the flow, it is 40 feet wide and up to 3 feet deep at Station 9. In general, both branches are steep, fast flowing streams.

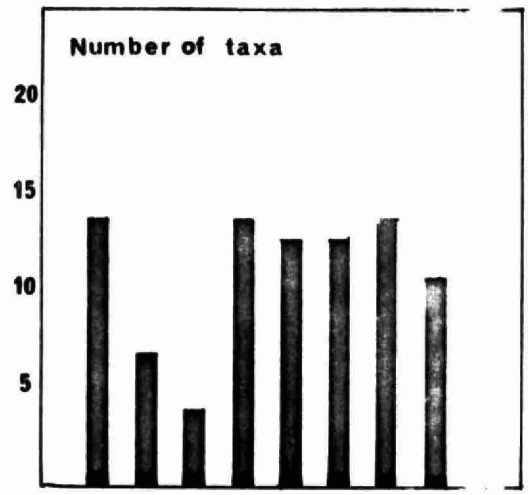
The Stouffville W.P.C. plant is an activated-sludge plant processing about 0.3 mgd. The effluent is chlorinated and passed through a sand-filtration unit. The Metropolitan Toronto and Region Conservation Authority has prepared plans for 90-acre multiple-purpose reservoir at a point 3 miles below Green River. Otherwise, the stream is used mainly in farming in an area which is noted for its excellent agriculture.

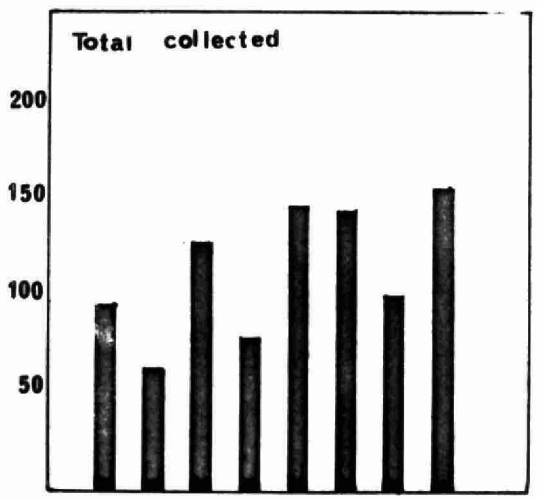
BIOLOGICAL ASSESSMENT OF WATER QUALITY

Although quite obvious changes in the bottom fauna which occur below Stouffville can be attributed to impaired water quality, generally, the stream is in reasonably good condition throughout most of its length. The number of taxa (mainly genera but families in the case of midges and tubificid worms) is reduced in and below Stouffville (Fig. 2). However, one species of mayfly, which as a group is intolerant of moderate pollution, was present immediately below Stouffville (Station 3). Amphipods, caddis larvae and damselfly larvae were present at Station 4, while riffle beetles, other mayflies and a varied population of molluscs, in addition to those above, were represented in the bottom fauna at Stations 7 and 8. At that point, 4 to 6 miles below Stouffville, recovery could be considered nearly complete, partly on the basis of a comparison with Stations 6 and 9 on the other branch where water quality was not impaired. It is significant however, that stoneflies, present at Stations 6 and 9, were not found below Stouffville. Considerable enrichment was obvious below Stoufville as indicated by the numbers of organisms collected in unit time, particularly at Stations 5, 7 and 10 (Fig. 2).

A summary of data on water quality, based on analyses of water collected by the Stream Sanitation Branch (now Water Quality Surveys Branch) of the Commission,







1 2 3 4 5 7 8 10

Fig. 2. Number of taxa and individuals collected from the bottom fauna at eight stations on the Stouffville branch of Duffin Creek in October, 1964.

Table 1. Summary of determinations of BOD, solids, nitrogen and phosphorus fractions and coliform densities made on samples collected by the Stream Sanitation Branch, O.W.R.C., on August 18 and 20, 1964.

Station	5-day	Solids Susp.	Solids Diss.	Nitrogen NH_3	Nitrogen NO_2 (ppm as N)	Nitrogen NO_3	Nitrogen TKN	Phosphorus Soluble (ppm as PO_4)	Phosphorus Total (ppm as PO_4)	Total coliforms (per 100 ml MF; log average)
1	0.6	16	276	0.03	0.0	0.0	0.64	0.1	0.9	5,500
Outfall	0.8	2	477	0.09	0.0	12.5	0.90	11.8	24.0	22,000
3	1.6	48	333	0.09	tr.	1.5	0.86	4.5	6.9	26,900
4	2.4	48	373	0.01	0.02	2.8	1.12	3.9	4.9	7,080
5	2.3	20	354	0.12	0.03	2.5	1.19	4.3	5.1	18,600
7	1.6	10	318	0.09	0.02	0.8	0.81	2.6	3.6	3,160
8	1.5	11	278	0.08	0.01	0.5	0.69	2.8	4.4	632
9	0.9	8	241	0.05	0.0	0.0	0.41	0.1	0.1	1,820
10	1.3	8	237	0.08	tr.	tr.	0.47	0.6	0.7	214

has been added to this report (Table 1). Suspended solids were high at Stations 3 and 4 (48 ppm) but the B.O.D. in the stream was only slightly elevated. The levels of nitrogen and phosphorus were increased by about five and twelve times, respectively. The change in the diurnal oxygen balance in the stream below Stouffville resulted partly from the increased organic load in the stream, but probably mainly from the general elevation of the level of autotrophic production by algae, notably Cladophora sp. which was abundant in a zone of high production extending from Station 5 past Station 7 (Table 2). Widest fluctuations in the concentration of dissolved oxygen occurred at Station 7 (54 to 154 per cent). At Station 9, which can be referred to as having a normal oxygen cycle, concentrations of oxygen were more uniform (68 to 104 per cent). The lowest levels of oxygen observed on the Stouffville branch were 3.9 ppm at Station 2 and 4.5 ppm at Station 5. Minimum levels before sunrise exceeded 5.5 ppm at Stations 7 and 8. These data tend to support the biological data of the survey, particularly as both sets of data indicate practically complete recovery in the stream 4 miles below Stouffville. However, data on B.O.D. and solids add little to an understanding of the effects of the waste discharge on water quality in this stream.

An examination of data on fish populations serves well in verifying the observations noted above. Some depression in the number of species occurred at Stations 2 and 3, but a varied population was present downstream (Fig. 3). In fact, one brook trout was taken at Station 4 and the rainbow darter and long-nose dace, both intolerant of moderate pollution, were present.

The tremendous increase in standing crops of fish is apparent (Fig. 3). It is interesting that a maximum standing crop of fish occurred at Station 7, where variations in the diurnal oxygen cycle, often considered as a measure of primary productivity, were most extreme. By comparison, standing crops at

Table 2. Average and extremes in dissolved oxygen in the upper West Branch of Duffin Creek determined by the Stream Sanitation Branch by daytime and nighttime sampling on August 19, 20 and 21, 1964.

Station	Dissolved Oxygen[1,2]		
	Average	Maximum	Minimum
1	9.1 (83)	9.8 (93)	8.2 (73)
2	5.1 (52)	6.5 (58)	3.9 (42)
3	7.9 (77)	9.2 (96)	7.1 (68)
4	8.4 (84)	12.4 (138)	6.3 (61)
5	8.3 (83)	14.7 (150)	4.5 (55)
7	9.3 (93)	15.0 (154)	5.5 (54)
8	9.2 (93)	12.9 (137	6.5 (65)
9	9.0 (89)	10.4 (104)	6.7 (68)
10	9.5 (96)	12.7 (137)	7.3 (71)

1. Expressed in ppm (per cent saturation in parentheses)
2. Station 6 was not examined by the Stream Sanitation Branch.

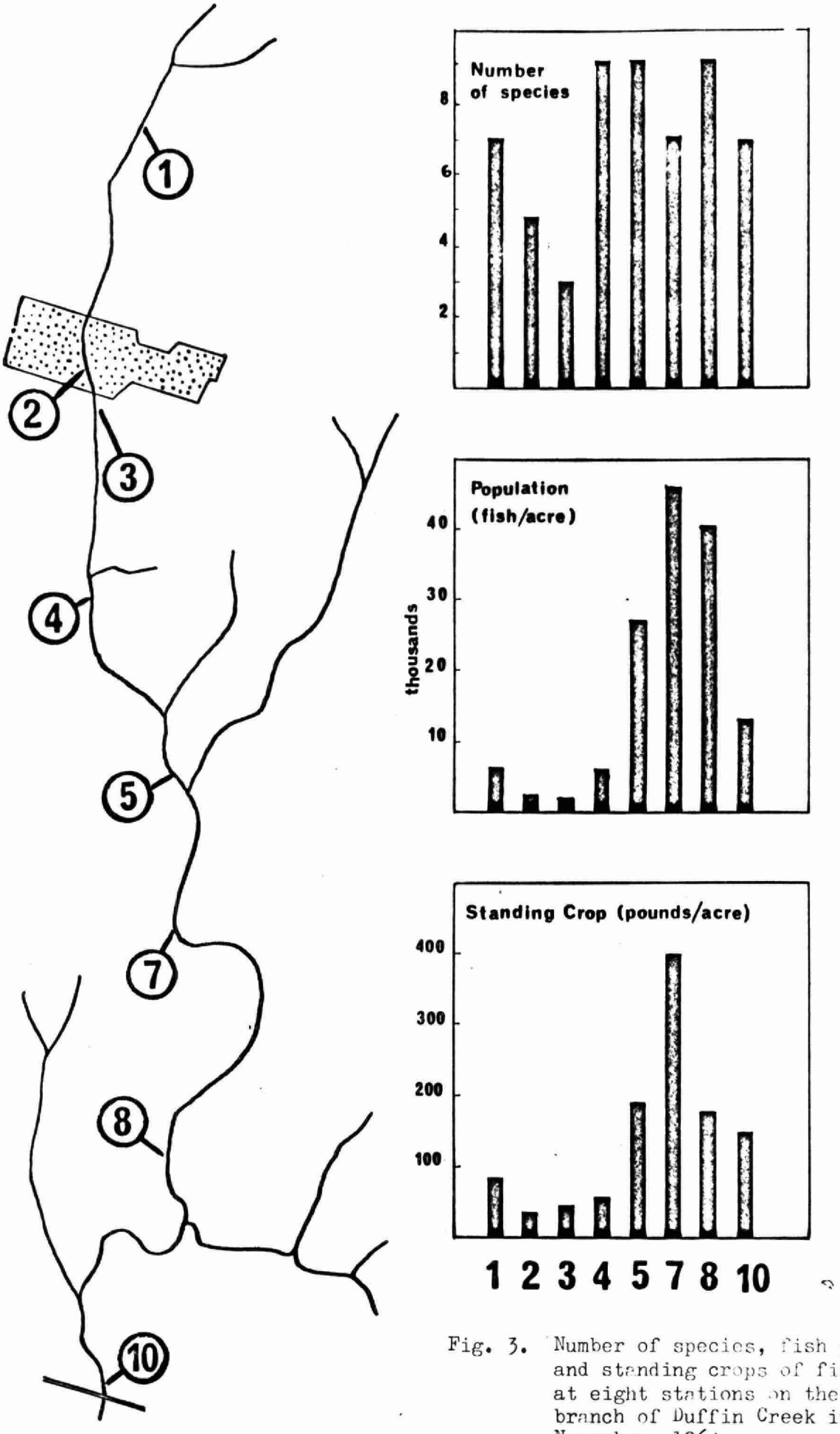


Fig. 3. Number of species, fish per acre and standing crops of fish taken at eight stations on the Stouffville branch of Duffin Creek in November, 1964.

Stations 6 and 9 on the other branch were 130 and 120 pounds per acre, while at Station 7 an estimate of close to 400 pounds per acre was obtained.

SIGNIFICANCE OF BIOLOGICAL RESULTS

Impairment of water quality immediately below Stouffville was evident. A reduction in the number of species of fish and elimination of many pollution intolerant invertebrate forms occurred below the point of waste discharge. However, signs of recovery were evident at Stations 4 and 5 and from a practical point of view, recovery from organic loading appeared to be complete at Stations 7 and 8, 4 to 6 miles below Stouffville. Even at that point certain dissimilarities were evident in relation to populations at Stations 6 and 9 on the adjacent branch.

Enrichment by high levels of phosphorus and nitrogen elevated all levels of production through Stations 5, 7 and 8 and beyond Station 10. The luxuriant development of Cladophora, large populations of invertebrates such as amphipods and net-spinning caddis and increased standing crops of forage and coarse fish demonstrate the high degree of fertilization of the water of this small stream. This nutrient-rich flow will have significant effects on the multiple-purpose reservoir that will be constructed downstream. Although the sanitary quality of the water should be acceptable because of good secondary treatment, chlorination and sand-filtration of waste water at Stouffville, the strong likelihood of problem growths of vascular plants and algae in the Clarke's Hollow Reservoir is apparent. Use of the reservoir for swimming, boating and fishing could be impaired seriously by a superabundance of algae and submergent aquatics. The Metropolitan Toronto and Region Conservation Authority has drawn attention to the relationship between water quality and its recreation program on streams of the region (M.T.R.C.A., 1963). The benefits of expanding treatment facilities in the future

to maximize the removal of phosphorus and other nutrients may become considerable as development of the reservoir takes place.

In conclusion, the biological survey indicated that water quality in the West Branch of Duffin Creek was moderately impaired through the first mile below Stouffville and that recovery from organic pollution was practically complete 4 miles below the village. Heavy fertilization of the stream stimulated all levels of production downstream and the possible adverse effects on a multiple-purpose reservoir to be built on the West Branch of Duffin Creek were indicated.

References

Johnson, M. G. 1965. Estimates of fish populations in warmwater streams by the removal method. Trans. Amer. Fish Soc. 94 (4) :350-357.

Metropolitan Toronto and Region Conservation Authority. 1963. Pollution control and recreation in the Metropolitan Region, June, 1963, 52 pp.

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APPENDIX

Table 1. Specimens collected at 10 stations on the West Branch, Duffin Creek, 1964.

Collecting methods are outlined in the text of report.

Table 2. Estimated numbers (per acre) of fish at each of the stations on the upper West Branch of Duffin Creek as determined using the removal method, November, 1964.

APPENDIX

Table 1 Specimens collected at 10 stations on the West Branch, Duffin Creek, 1964.
Collecting methods are outlined in the text of report.

Taxa		STATIONS 1	2	3	4	5	6	7	8	9	10
STONEFLIES	Togoperla						1			5	
	Neophasganophora									1	
MAYFLIES	Baetis	3	50	3	3				1		
	Choroterpes								1		
	Stenonema		1				26		3	9	
	Caenis					1					
	Tricorythodes							1			
CADDISFLIES	Hydropsyche	16	3			2					
	Cheumatopsyche	11			6	41	28	40	25	37	71
	Rhyacophila	7									
DAMSELFLIES	Agrion						3		1	3	
	Aeschna	1									
	Ischnura				1	2	1	15	2	3	14
FLIES	Tipula									1	
	Tabanus	2		3	1	1	2				
	Simulium	12			13	1				2	3
	Atherix						4				
	Pedicia								1		
	Tendipedidae	3	5	119	7	2	6	19	12	40	29
BEETLES	Optioservus	3	3				7	5	8	17	12
	Psephenus				10		1	1			
	Hydroporus	5									
ISOPODS	Lirceus										1
	Asellus		2		13						
AMPHIPODS	Hyallela				9	93		45	37	4	20
	Crangonyx				9						
LEECHES	Erpobdelle	2		5	2	1			1		
	Helobdella				2						
	Glossiphonia				3	1		2	3		
MOLLUSCS	Sphaerium						18	2		5	
	Pisidium	1				2	2	3	3	3	1
	Helisoma						8	6			2
	Physa	20	1			1	35	4	5	8	1
	Lymnaea						1				
	Ferrissia						1	4			
TUBIFICIDS	Unidentified	6			1	2	4				4

Table 2. Estimated numbers (per acre) of fish at each of the stations on the [illegible] West [illegible] of Duffin Creek as det[illegible]d using the removal method, [illegible]

Species	1	2	3	4	5	6	7	8	9	10
Brook trout	470			20		50				
White sucker	260	1560	580	150	1450	1040	240	2180	9[illegible]	
Creek chub	20	470	230	1530	7190	950	920	860	2[illegible]	
Blacknose dace	1540	290	1070	1550	9390	4280	14180	13720	[illegible]	1[illegible]
Long[illegible]	50			130	[illegible]	[illegible]	720	[illegible]	[illegible]	[illegible]
Pathead minnow	50			90						
[illegible]		90		1020	40	450		570	730	[illegible]
Common shiner				150	370	[illegible]	8960	3030	2720	
Stone cat									30	60
[illegible]					40			30	[illegible]	30
[illegible]								30	[illegible]	240
[illegible]		30		[illegible]	4[illegible]	1[illegible]		110	[illegible]	[illegible]
Johnny darter					2530	410	600	[illegible]	3710	
[illegible]	1,120									